Solution for Liquid Level Detect error of BS200

I. General

When aspirating samples/reagents and dispensing sample in reaction disc, the BS-200 chemistry analyzer requires the probe to dip into the liquid for a specific depth (3mm below the liquid level), so as to avoid carryover that has impacts on test results, and to avoid air aspiration when the reagent/sample is insufficient. Also when washing the probe in washing pool, probe also need to stay at a special depth to wash the inner part and outer part.

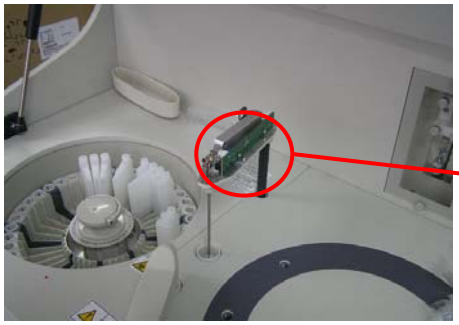
II. Composition of Level Detection System

The Level Detection System consists of:

1) Sample/reagent probe,
2) Liquid level detection board,
3) Electric wire from liquid level detection board to probe connection board,
4) Electric wire from liquid level detection board to main board,
5) Main board.

✓ **Liquid Level Detect board**

The level detection board requires the 5V and 9V voltages. The 9V voltage is the working voltage of the phase-locked loop, and 5V is the working voltage of other components on this board. The main control board supplies this board with a 12V voltage, which is converted into the 5V and 9V voltages as required.



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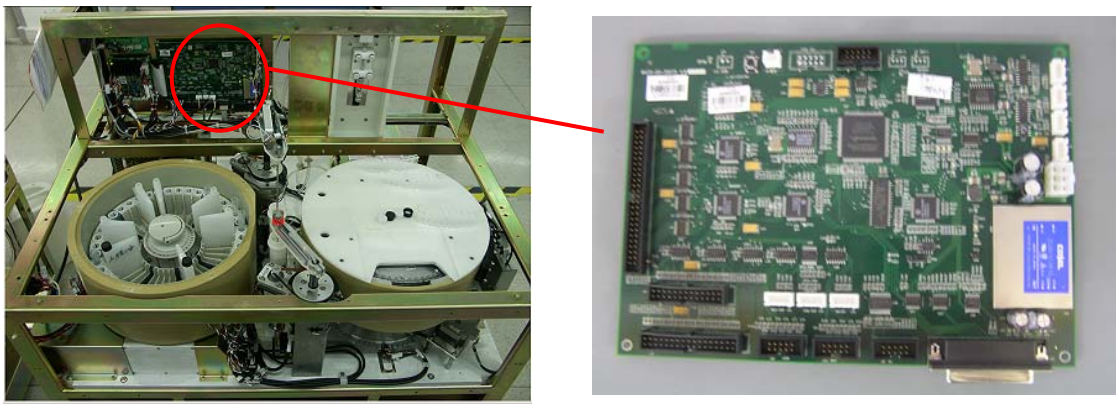
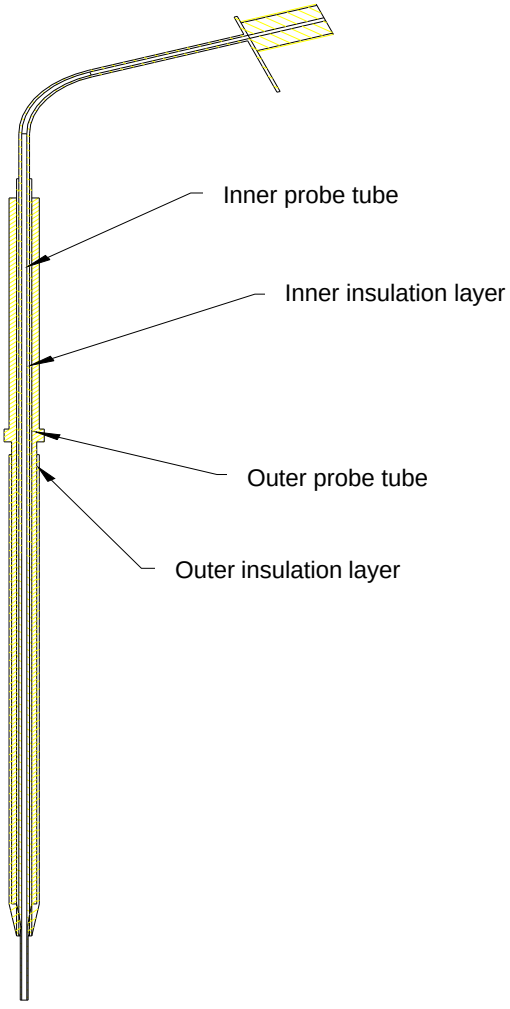
✓ **Main board**



✓ **Sample/reagent Probe (Dual-tube)**

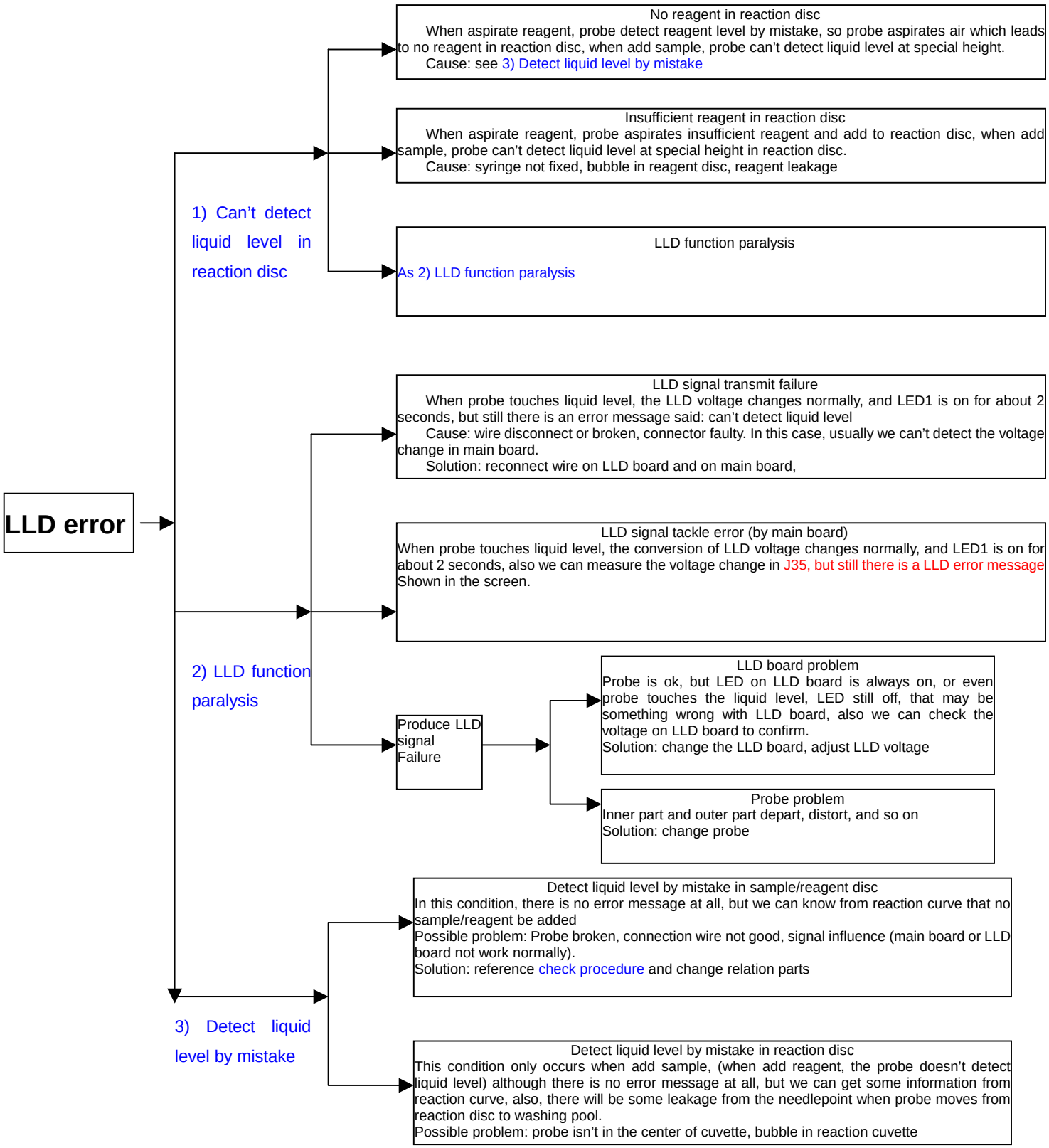


III. Level Detection process

When the sample/reagent probe touches the sample/reagent level, there will be a change in the capacitance between the two tubes inside the probe. As the capacitance

changes, the phase changes. The phase discriminator then outputs a voltage variation, which will be filtered by a low-pass filter. After that, a band-pass filter takes the variation and reshapes it to pulse signals, which are finally transmitted to the MCU of the main control board.

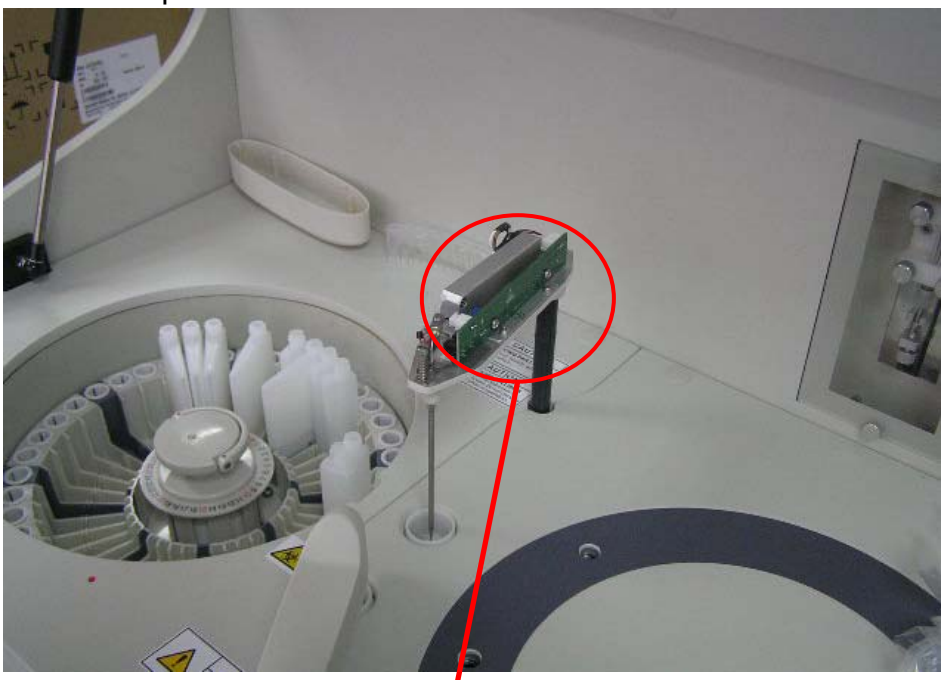
IV. Check procedure (please enlarger the font to see clearly)


LLD error
1) Can't detect liquid level in reaction disc
No reagent in reaction disc
When aspirate reagent, probe detect reagent level by mistake, so probe aspirates air which leads to no reagent in reaction disc, when add sample, probe can't detect liquid level at special height.
Cause: see 3) Detect liquid level by mistake
Insufficient reagent in reaction disc
When aspirate reagent, probe aspirates insufficient reagent and add to reaction disc, when add sample, probe can't detect liquid level at special height in reaction disc.
Cause: syringe not fixed, bubble in reagent disc, reagent leakage
LLD function paralysis
As 2) LLD function paralysis
2) LLD function paralysis
LLD signal transmit failure
When probe touches liquid level, the LLD voltage changes normally, and LED1 is on for about 2 seconds, but still there is an error message said: can't detect liquid level
Cause: wire disconnect or broken, connector faulty. In this case, usually we can't detect the voltage change in main board.
Solution: reconnect wire on LLD board and on main board,
LLD signal tackle error (by main board)
When probe touches liquid level, the conversion of LLD voltage changes normally, and LED1 is on for about 2 seconds, also we can measure the voltage change in J35, but still there is a LLD error message Shown in the screen.
Produce LLD signal Failure
LLD board problem
Probe is ok, but LED on LLD board is always on, or even probe touches the liquid level, LED still off, that may be something wrong with LLD board, also we can check the voltage on LLD board to confirm.
Solution: change the LLD board, adjust LLD voltage
Probe problem
Inner part and outer part depart, distort, and so on
Solution: change probe
3) Detect liquid level by mistake
Detect liquid level by mistake in sample/reagent disc
In this condition, there is no error message at all, but we can know from reaction curve that no sample/reagent be added
Possible problem: Probe broken, connection wire not good, signal influence (main board or LLD board not work normally).
Solution: reference check procedure and change relation parts
Detect liquid level by mistake in reaction disc
This condition only occurs when add sample, (when add reagent, the probe doesn't detect liquid level) although there is no error message at all, but we can get some information from reaction curve, also, there will be some leakage from the needlepoint when probe moves from reaction disc to washing pool.
Possible problem: probe isn't in the center of cuvette, bubble in reaction cuvette

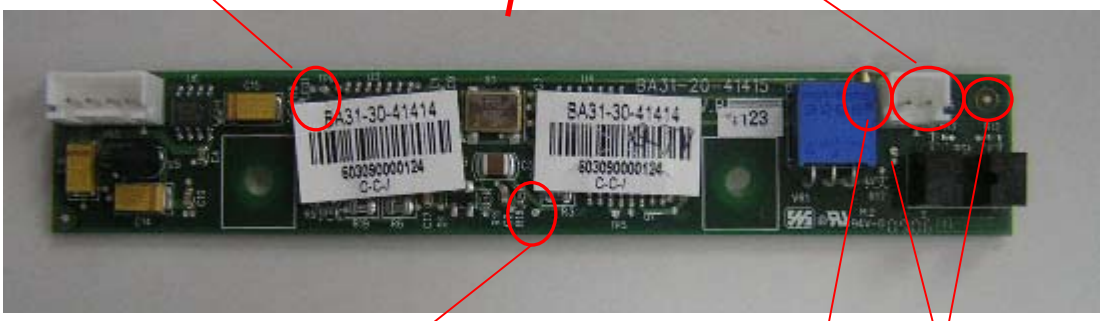
V. Convert defective parts

(a) LLD voltage adjustment

Location of the liquid level detect board:



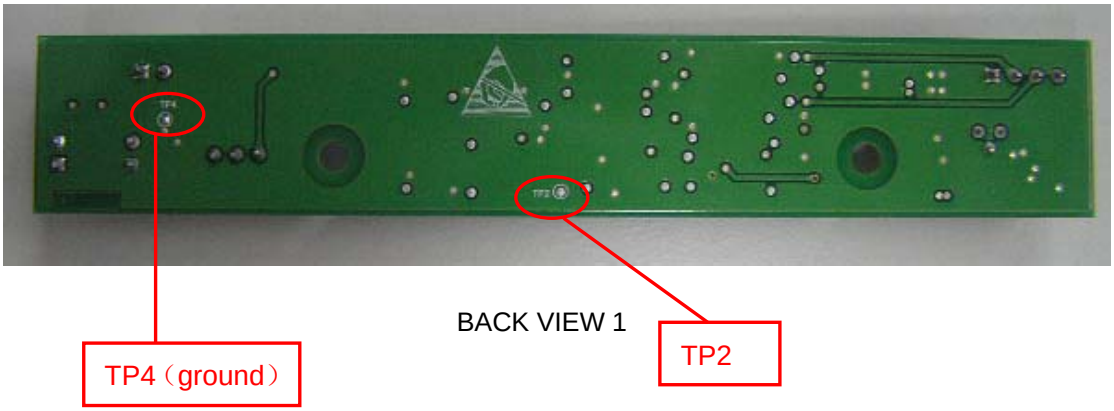
Liquid Level Detect board:



What we need to do is like below:

1) Detach the cover of probe arm.

2) Find TP2, TP4, and the VR1 (marked above)



3) Adjust VR1, to make voltage between **TP2** and **TP4** are **4.5** volt.

Remember: every time after we convert a new probe or LLD board, we need to adjust LLD voltage to 4.5V.Also,this adjustment is the foundation of solution for LLD error.

(b) Replace probe

(i) Removing the old Probe

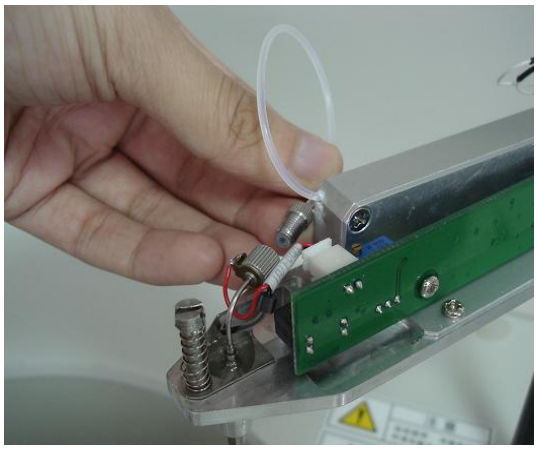
Before replacing or unclogging the probe, remove it first in the following procedures:

1. Place the Power of the analyzing unit to OFF.
2. Pull the probe arm to the highest point by hand. Rotate the probe arm to a position above the sample/reagent disk for convenient operation.
3. Grab the lower part of the arm covers with two hands and pull them slightly outwards and remove the cover upward from the arm base.

Removing the arm cover

4. Disconnecting the probe from the tubing.

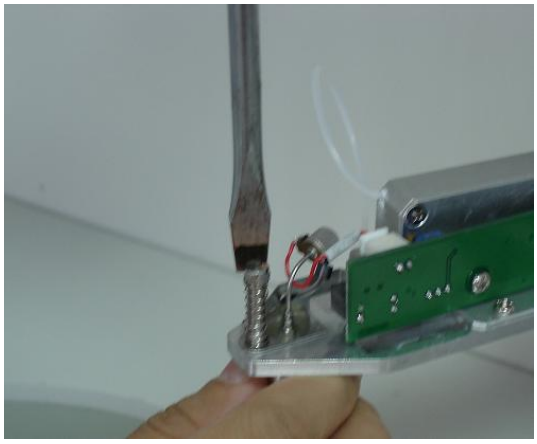
Hold the probe's fluid connector with one hand and the tubing connector with the other. Rotate the tubing connector counter-clockwise until it is loosened. Unplug the tube from the probe.



Disconnecting the probe from the tubing

5. Removing the retaining screw of the probe

Remove the retaining screw with a screwdriver and take away the spring.



1 Removing the retaining screw

6. Unplugging the lead of the level detector

The probe arm is delicate. Exercise caution when disconnecting the connector. Excessive force may damage the connector and/or the level detection board.

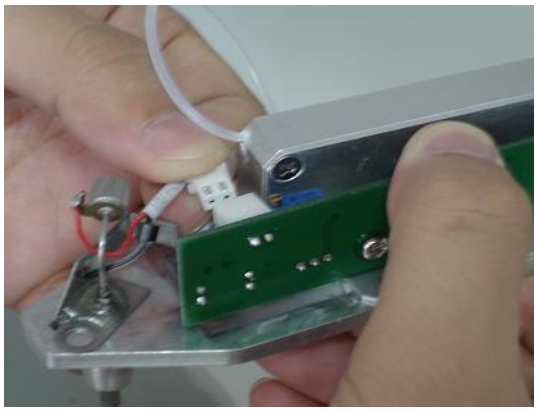


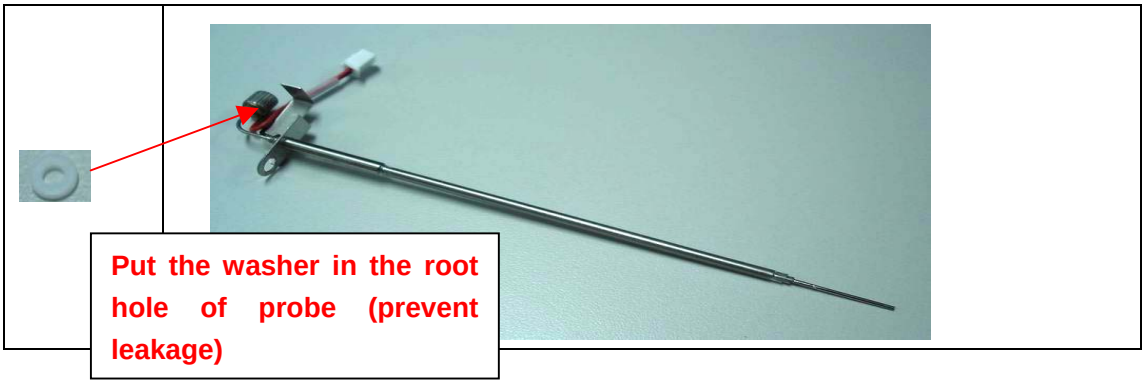
图 2 Unplugging the connector

7. Removing the probe

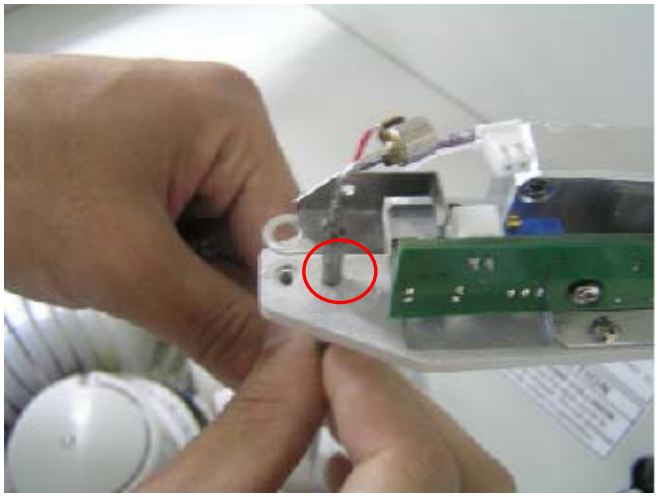
Slowly pull the probe away from the probe arm.

(ii) Install new probe

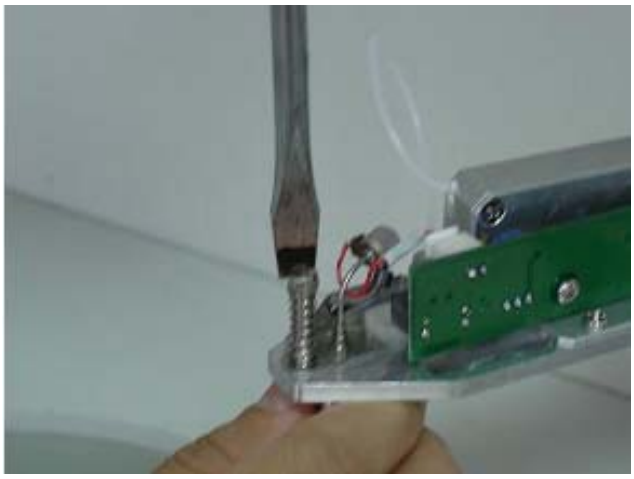
1. Add the small washer in to the probe.



2. Insert the probe into the probe arm.

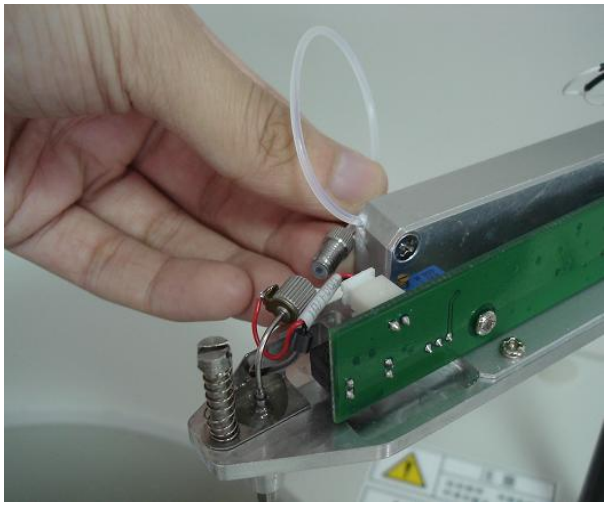


3. Sleeve the spring over the pole in the probe arm, and screw the retaining screw back onto the pole.



4. Insert the connector of the probe lead into corresponding jack on the level detection board. The probe arm is delicate. Exercise caution when inserting the connector. Excessive force may damage the connector and/or the level detection board.

5. Screw the probe's fluid connector back to the tubing connector. Note that excessive force may bend the probe.



6. Then push the probe upward and then release the probe to check if it can move

freely. If not, find the reason and solve the problem.

7. Adjust the liquid level detect voltage to 4.5V as (a).
8. Installing the arm cover.

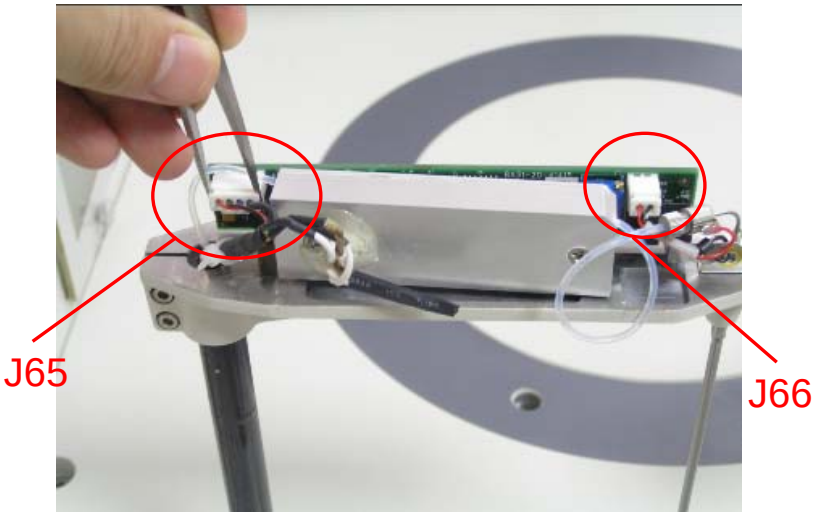
9. Pinch the probe by the part near the probe arm. Gently push the probe upward and then release the probe to see if it can move freely. If not, remove the arm cover and re-install it.

10. Do some tests to check whether every thing is ok.

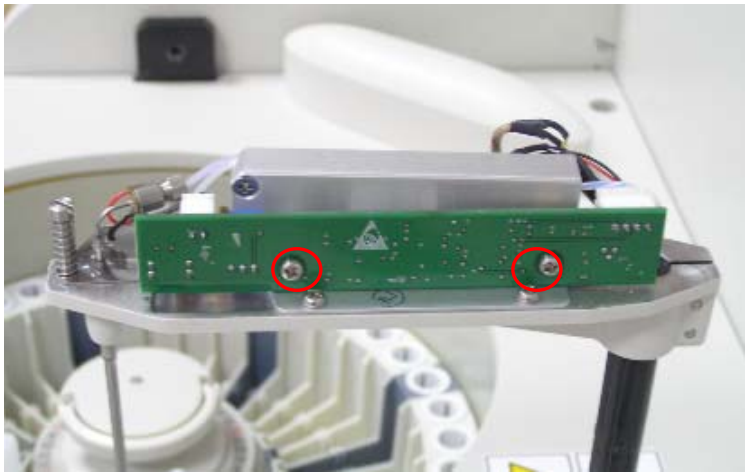
(c) Replace LLD board

1. Detach the arm cover.

2. Unplug J65 and J66



3. Disconnect the 2 screws and we can detach the LLD board.



4. Change the board.

5. Set everything back and remember to adjust LLD voltage to 4.5V as procedure (a), and pinch the probe by the part near the probe arm. Gently push the probe upward and then release the probe to see if it can move freely.

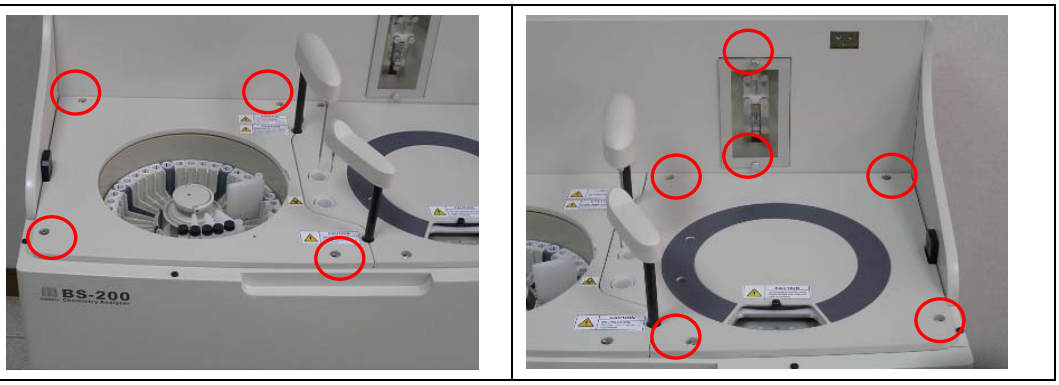
We should make sure the block board of probe in the sensor

(d) Replace Main board

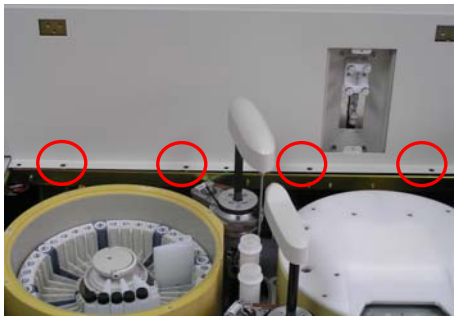
1. Detach the screws, and we can detach the protective cover.

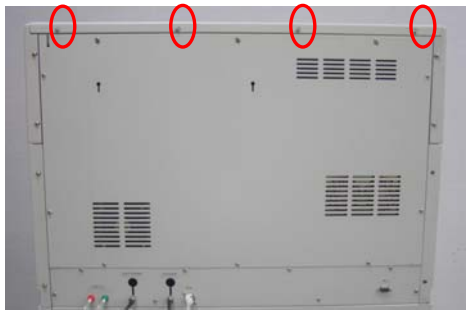
There are totally 3 screws each side

2. After that, detach the 10 screws and we can remove the desk cover.



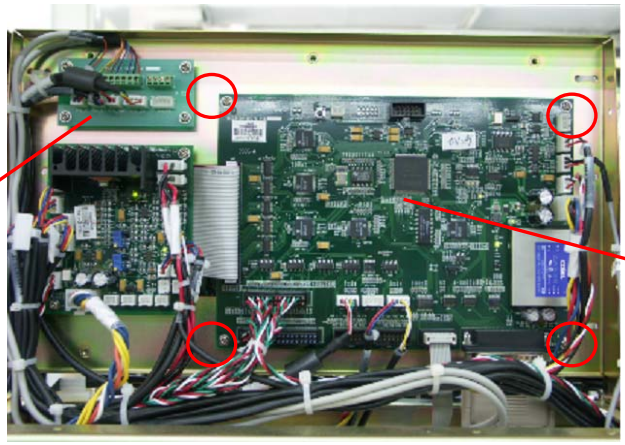
3. Remove the 8 screws below, and detach the cover of board and syringe.





4. We can see the main board

5. Just disconnect the four screws and all of the connectors; we can change the main board.



6. Set everything back.

VI. Check procedure of LLD signal

1. First, we need to know how to simulate LLD and collision function. Two picture below indicates the method.

Simulate collision function

Simulate LLD function

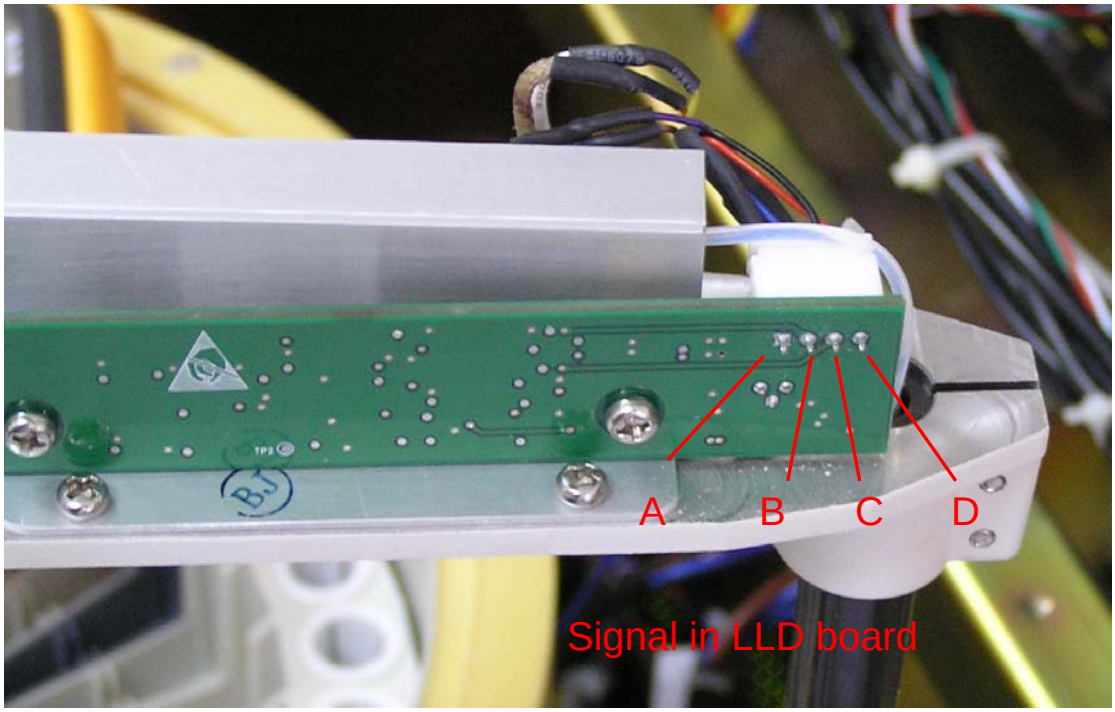
Not touch liquid level **Touch liquid level**

Detach relation parts until we can see the main board and LLD board. (See procedure d)

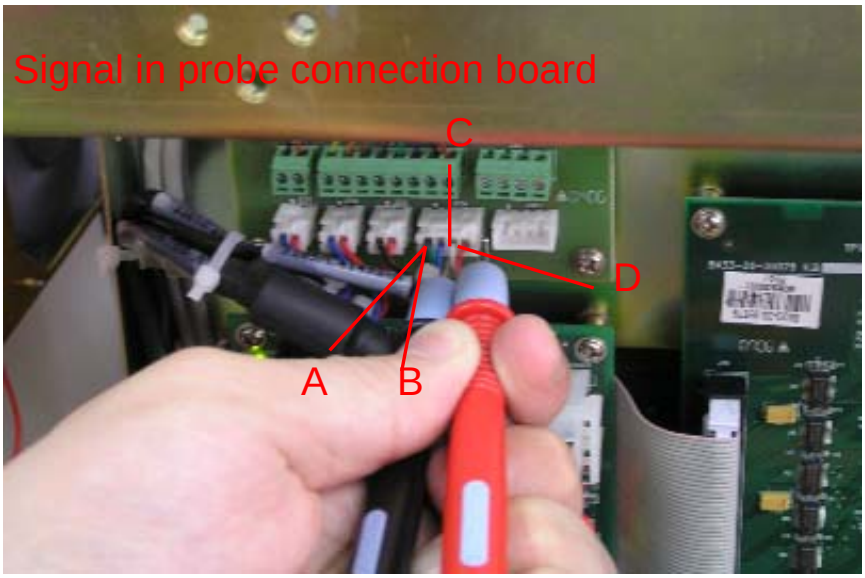
2. Turn on the main power and analysis power.
3. Adjust LLD voltage on LLD board to 4.5V(TP2 and TP4). When detect liquid level, voltage between TP2 and TP4 should rise more than 4.5v(4.8v, 5v,and so on), if we can't do this, or we can do this but there is LLD error, please turn to step 5.

4. Check the LLD signal in LLD board (in this condition, you'd better ask a people to help you simulate LLD and collision function):

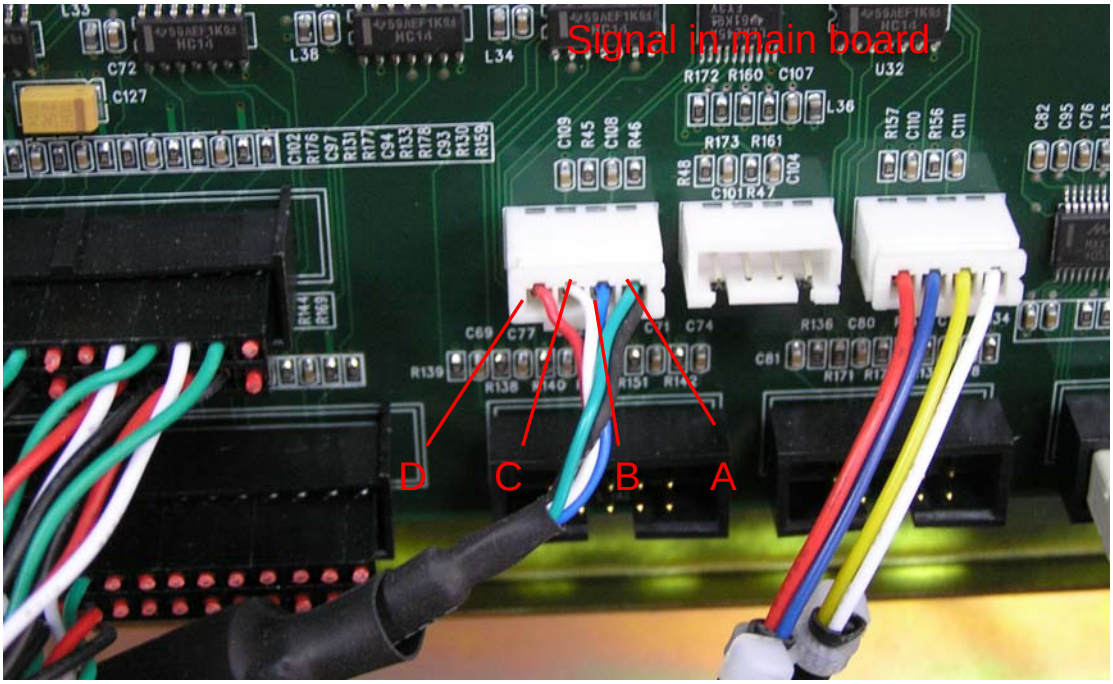
Signal in LLD board:



Signal in probe connection board:



Signal in main board:



Pin	Function	Description
A	Ground	**LLD**: normally point A and C is 0V,when the probe touches the liquid, voltage will suddenly change to 5v,and after about 1 second, back to 0V again. **Collision**: normally point A and B is 5V,when collision occurs, voltage will suddenly change to 0v. **Power supply** is always 12V without change.
B	Collision signal	
C	LLD signal	
D	Power supply	

VII. Summary (not finished)

Because BS200 only have one probe, one LLD board, and one syringe, so we can image that sometimes when LLD error occurs, always this error will happen in both sample disc and reagent disc. If only occurs in one disc, we should pay more attention to ample and reagent itself.